Elevating Grain Storage Practices

Word-of-mouth advertising is important to spreading good news and good practices among people. ARS entomologist David W. Hagstrum hopes that in a few years grain elevator operators will pass on information being gathered now that could save the wheat industry millions of dollars.

Stored-grain insects account for multimillion-dollar losses annually in this multibillion-dollar industry.

Each year, 2 billion bushels of wheat are produced in the United States, with most of it being stored at one time or another in an elevator. Some is stored before milling, but much of it is awaiting export to other countries. In either case, damage to stored grain by the lesser grain borer, rice weevil, red flour beetle, and rusty grain beetle costs the U.S. wheat industry about $500 million annually.

"Pest management is important for all types of grain elevators because insects move along with grain as it makes its way through the marketing system. Failure to control pests at just a few elevators can provide sources of insect infestation that can lower the quality of much larger quantities of grain as it's commingled in the marketing system," says Hagstrum.

Hagstrum is based at ARS' Grain Marketing and Production Research Center (GMPRC) in Manhattan, Kansas. Since July of 1998, he and other Kansas and Oklahoma scientists have been monitoring insect levels and current pest management practices at 13 elevators in Kansas and 15 in Oklahoma.

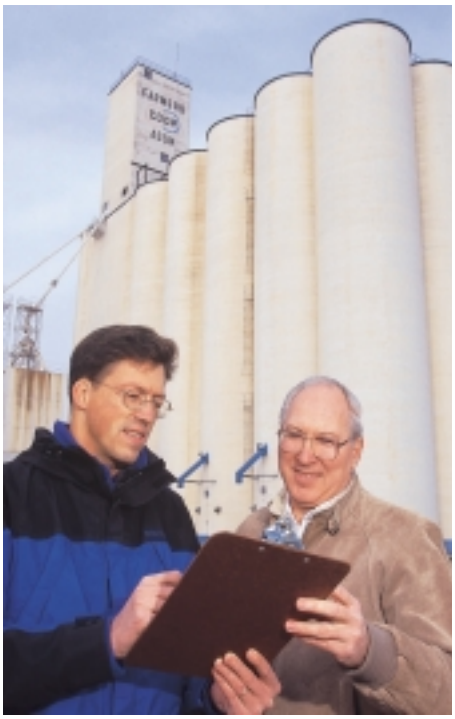
In the first year of this 5-year study, the scientists gathered baseline data, taking more than 20,000 grain samples from the 30 million bushels of wheat stored at these elevators.

"This effort is unique. These aren't laboratory studies; instead, they focus on day-to-day management practices of grain elevators—how these practices affect the cost and effectiveness of insect control and how, in turn, the economics of moving and storing grain are affected," says Hagstrum.

Integrated Pest Management

A collaborative effort between major grain-handling companies, Kansas State University, Oklahoma State University, and ARS, this study is the largest of its kind. Federal and state researchers are working with elevator managers through industry cooperators who own the networks of grain elevators. The purpose of the project is to evaluate procedures that might be useful in an integrated pest management (IPM) system for wheat storage.

PEGGY GREB (K8802-1)



Entomologists Paul Flinn (left) and David Hagstrum discuss sampling methods to use in the areawide integrated pest management (IPM) program for stored grain.

Sampling is a key tool for determining the level of insect infestation in the stored wheat. To estimate changes in insect populations, research technicians sampled grain from elevators in Kansas and Oklahoma and from trucks that deliver it to terminals. The researchers took three 1-gallon samples from every 1,000 bushels of wheat sampled—5 to 50 times larger than the commonly used sampling rate. They found that most of the wheat trucked to the elevators is relatively free of insects.

"Insects are detected with probe traps within a month after the grain enters the elevators," says R.F. (Skip) Allen, who manages the project in Hutchinson, Kansas. In Watonga, Oklahoma, Allen's counterpart is Stan Miller.

PAUL FLINN (K8812-1)

The lesser grain borer develops and feeds inside wheat kernels.

PEGGY GREB (K8806-1)

Insect-damaged kernels are caused by internal-feeding grain insects. If more than 32 damaged kernels are found per 100 grams of wheat, the value of the grain is greatly decreased.

Hagstrum and his team identified three main ways to improve integrated pest management: (1) cooling the grain

earlier in the season, particularly right after it enters the bin; (2) cleaning empty bins more thoroughly; and (3) fumigating wheat only when insect infestations reach unacceptable levels. All three practices create an environment in which beneficial insect parasites can thrive and attack the stored-grain insect larvae.

"These aren't necessarily new ideas," says Hagstrum, "but now we have substantial data to show they are cost-effective." Cooling newly harvested grain right after it enters the bin, rather than waiting until fall when elevators typically use fans to aerate (cool) the grain, can reduce insect problems and the cost of pest management. The cost of early cooling is less than fumigation, currently estimated at 1.57 cents per bushel for storage in steel bins and 2.35 cents per bushel for storage in concrete bins.

PEGGY GREB (K8809-1)

Biological technician Ken Friesen uses an inclined sieve to separate insects from a large wheat sample. The insects are identified and counted to estimate infestation in stored wheat.

Most grain elevators have thin wire cables to check the temperature of the grain inside. These cables run through the center of the bin from top to bottom. Sensors are positioned every 6 feet along the cable for measuring temperature.

"A conscientious elevator manager records the temperatures, keeping watch for any rise in temperature that might indicate the presence of insects," says Allen.

Data loggers—small recording devices attached to the aeration fans—are being used by the IPM researchers. "With these, we can show the workers how long the fans had been running—in some cases many hours after the grain had already cooled. Being able to automatically cut back on fan operating time helps save on energy costs," says Hagstrum.

These data will be welcome news for the grain-storage industry. One-third of the storage bins included in the project have aeration fans to cool the grain, but controlling devices are needed to shut the fans off when the outside air temperature is insufficient to cool the grain, according to Hagstrum.

Fewer Fumigations

"There are five or six species of tiny parasitoid wasps that range in size from 1/8 to 1/4 inch and are normally found living in grain. They are the 'good guys' because they don't feed on the grain but attack the larvae of the rusty grain beetle, lesser grain borer, and rice weevil," says Paul W. Flinn, an ARS entomologist at GMPRC.

The beneficial insects are another reason for reducing the use of fumigation—because it kills the good ones along with the bad. These tiny wasps don't pose a threat to grain quality because they're completely removed during ordinary grain cleaning.

Phosphine is the fumigant of choice for controlling beetles that damage stored grain. But the U.S. Environmental Protection Agency is proposing new risk-mitigating measures for phosphine.

"If fumigations were more effective and done only when needed, the risk of using phosphine could be substantially less for grain workers," says Flinn.

In 1995, Flinn and other GMPRC scientists designed a computer program, Stored Grain Advisor, for farmers and grain elevator operators to predict when insect infestations will reach levels requiring chemical pest control. The computer program is available on the World Wide Web at http://bru.usgmrl.ksu.edu/flinn/sga. As part of the areawide IPM project, the scientists are developing an advanced version, Stored Grain Advisor Pro, which will be available free to the public on the GMPRC web site by the end of the project.

The Kansas-Oklahoma areawide project is one of several ARS programs developed in response to USDA's 1994 Integrated Pest Management Initiative. Recommendations based on this research are expected to be made in 2002. That's when word-of-mouth advertising should reach its peak, hopes Hagstrum.

The benefits of areawide IPM are within reach. Fewer workers will be exposed to fumigants and fewer insects will be able to develop resistance to fumigants. Ultimately, these measures should strengthen the competitiveness of U.S. wheat in the export market.—**By Linda McGraw,** ARS.

This research is part of New Uses, Quality, and Marketability of Plant and Animal Products, an ARS National Program (#306) described on the World Wide Web at http://www.nps.ars.usda.gov/programs/cppvs.htm.

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